Deprez.—An experiment in physiological optics, by M. Bibart. —Measurement of the refractive indices of liquids, by MM. Macé de Lépinay.

## SOCIETIES AND ACADEMIES

### LONDON

**Royal Society**, May 27.—"A Preliminary Account of the Reduction of Observations on Strained Materials, Leyden Jars, and Voltameters," by John Perry and W. E. Ayrton. Communicated by Prof. G. G. Stokes, Sec. R.S. [Abstract].

In discussing the residual-charge phenomena of condensers, the authors point out that in spite of certain elaborate measurements which have been made on different kinds of glass, nobody has yet discovered a constant such that it expresses the residual charge property of a particular substance. They therefore say that the simple plan of charging a Leyden jar for a long time, short-circuiting for a small definite period, then insulating and giving the residual charge at certain times from insulation (thus getting say three definite numbers for each dielectric experimented upon), is more accurate than, and is just as definite as, any plan hitherto proposed for determining the residual-charge properties of a dielectric. They show that if Prof. Clerk Maxwell is right, the only correct means of studying these properties are given by the constants of Maxwell's differential equation, and they describe experiments on the Leyden jar of a Thomson's electrometer, and reductions of observations to obtain such constants. Thus one such constant is found to satisfy all the observations made from the 500th to the 900th minute of insulation of a jar. The authors draw attention to the analogy which they have pointed out between condensers and voltameters charged by electromotive forces less than one and a half volts, and show that if we assume Maxwell's equation to be true for voltameters, that is, if we assume a voltameter to be a condenser, one constant satisfies observations from the 50th to the 190th minute of charging, and from the 20th to the 80th minute of discharging. They then proceed to develop a theory of the increasing strains in bodies subjected to constant stresses. When a homogeneous substance is suddenly subjected to stress, there is a suddenly produced strain which follows Hooke's law, depending on a constant $k$, but besides this there is a viscid increase of strain whose rate is proportional to the stress depending on a constant $r$. In steel the viscous strain is not of much importance, whereas in water strained by bodies moving in it it is very important, as it is also when a beam of sealing wax is loaded. They show that the viscid increase of strain is exactly analogous with the flow of electricity in accordance with Ohm's law, and that the suddenly-produced strain is analogous with induction; and considering a heterogeneous material subjected to shearing stress, they find that the above assumptions lead, for strained materials, to exactly the same equation as Prof. Maxwell found for condensers. They found that the support of this theory is exactly the same as the support which they have given of Maxwell's theory of condensers. Thus one constant of the equation satisfied the recovery from deflection of a glass beam from the 4th to the 240th hour of relief, and satisfied the recovery from twisting of a glass fibre for all but the first few observations. They have also constructed a voltameter such that the platinum electrodes may be maintained at any temperature in an atmosphere of any gas for any length of time, maintaining a vacuum over the liquid or saturating it with any gas, and they give the different values of the residual charge constant, which satisfies all but the first few observations of charge and discharge in different cases. The authors conclude their paper by saying that, regarding a voltameter as a condenser, then as the plates of the charging battery are larger and nearer together, and as the times of charge and discharge of the voltameter are made less and less, the more do the total quantities of the charge and discharge approximate to one another.

**Physical Society**, June 26.—Prof. W. G. Adams in the chair.—Mr. C. V. Boys read a paper, by Prof. Guthrie and himself, on the measurement of the conductivity of liquids by means of magneto-electric induction. The liquid is suspended in a glass vessel by a fine iron wire in the centre of a cylindrical electro-magnet formed of two semicircular parts. This electro-magnet is rotated at a velocity not exceeding 3,000 turns per minute, and the liquid being drawn round in the direction of rotation, the wire is subjected to torsion, which, under correction for certain errors, is proportional to the resistance of the liquid. The torsion is observed by means of a scale and microscope The results, plotted in a curve, agree very closely with those of Kohlrausch, obtained by alternate currents, and Dr. Guthrie thinks that they are probably more correct and trustworthy than Kohlrausch's, for the method would seem to be superior and the curve contains fewer excentric points than his.—Dr. Gladstone read a paper on the refraction equivalents of isomeric bodies, in which he described the present state of the subject and his own contributions to it. He showed that the refractive power of bodies over light was of great importance to chemists, since it depended on their essential structure.—Dr. Huggins described his latest results of star spectra, and illustrated his remarks by photographic spectra taken by his improved method. From these it appears certain stars, such as Vega, give a complete spectrum of hydrogen. Others, more yellowish in colour, show a thinning of these lines, such as Sirius, $\eta$ Ursæ Majoris. Others show the intrusion of more refrangible lines; for example, Arcturus, $\alpha$ Aquila, $\alpha$ Virginius; while Capella gives a complex spectrum like that of the sun. Dr. Huggins also showed a spectrum of the flame of a spirit lamp, which presented a strong group of lines at S, and he considered it to represent the light emitted by the molecules of water. He further observed that the spectrum offered a highly sensitive test of the presence of carbon.—Mr. Liveing exhibited a new fire-damp indicator, capable of detecting ¼ per cent. of marsh gas in air. It is based on the fact that an incandescent body shows more brilliantly in proportion to the amount of marsh gas in the air, and consists of two fine platinum wires kept incandescent by a magneto-electric current sent through them in one circuit. One wire is excluded from the fire-damp, the other is exposed to it, and the relative intensities of the two glowing wires is compared by a photometric screen placed between them and adjustable to a position between them at which the reflections of the wires on the screen are of equal intensity. The position of the screen relatively to the wires is given by a scale, and measures the proportion of fire-damp in the air. This contrivance is more advantageous than the safety-lamp, which only indicates 2 per cent of marsh gas in the air.—Dr. Stone exhibited a vacuum-tube of variable resistance and a large electro-magnet wound with iron wire. The former consists of a barometer-tube thirty-two inches long, terminating above in a short vacuum-chamber arranged transversely, and closed at either end by adjustable india-rubber stoppers, through which platinum terminals are passed. Above this the vertical tube is continued to a glass stopcock, by means of which small quantities of air can be introduced. The foot of the tube is attached to an india-rubber flexible pipe with a cistern like that of Frankland's gas apparatus. The cistern full of mercury is counter-balanced, and can be raised or lowered at will through the whole thirty-two inches. A Torricellian vacuum can thus be made in the upper chamber, or one of more or less perfectness. On passing the induction-spark between the terminals in the former case all the discharge is carried off, none appearing at the discharger. By gradually raising and lowering the cistern, after admitting a little air by the stopcock, the resistance of the partial vacuum thus obtained can be altered within wide limits. A point can also be found where the spark of breaking-contact is shunted through the vacuum-tube, while the weaker discharge of making-contact is stopped. The induction-current is thus obtained in a single direction, a matter of some importance in physiological experiments. The electro-magnet could not be described from pressure of other matter. Its peculiarities consisted in its being wound with best charcoal-annealed wire of about 5 millim. section in four parallel circuits, and in each pole being cast, after winding into a solid block of paraffin. It was expected that the latter device would increase the inductive effect of the spirals; and indeed it appeared that the lifting power was somewhat strengthened. The cores had been originally wound with large copper wire of about the same weight as the iron wire. But the lifting power for batteries of moderate size, five or six Bunsen's cells, for instance, had increased fourfold after the substitution.—A paper by Mr. McFarlane Gray entitled specific heats calculated from entropy. This is a re-affirmation of a paper on the value of $v$, declined by the committee of the Royal Society in February, 1878. The author read a paper at the last meeting of the Institution of Naval Architects, which we said was a singularly bold and original attempt to account for many of the phenomena of steam and other effects of heat when applied to matter. In the present paper Mr. Gray continues in the same line of startling generalisation. The following is a specimen:—Taking the $p\,v$ of hydrogen at 493°·2 F., as in Rankine's tables, to be 378819 foot pounds, he writes—

$$u = \frac{mpv}{J\theta} = \frac{2 \times 378819}{772 \times 463{\cdot}2}\, 1{\cdot}989856.$$

The letter *u* in the paper with the value obtained as above is applied in the following remarkable generalisations: *m* being the molecular weight of the substances, and *p v* and *θ* being the pressure, volume, and absolute temperature in any standard units.

$$\text{The thermal equivalent of } pv = \frac{u}{m}\,\theta$$

$$\text{Specific heat at constant volume} = 2\tfrac{1}{2}\,\frac{u}{m}\,\theta$$

$$\text{Specific heat at constant pressure} = 3\tfrac{1}{2}\,\frac{u}{m}\,\theta$$

The specific heat in the gaseous state is therefore at constant pressure.

$$\frac{3\tfrac{1}{2} \times 1{\cdot}989856}{17{\cdot}96} = {\cdot}387779$$

for $H_2O$, water in the gaseous state. By calculating the difference of entropy for water at numerous temperatures for the different states of aggregation, first absolute $H_2O$ without energy volume, secondly, water as we know it with a volume increasing with temperature; thirdly, water split into single molecules, but these yet without motion; fourthly, single molecule $H_2O$ or steam gas; he shows that the difference of entropy between the third and the fourth state is equal to the specific heat at constant pressure, and that the whole energy possessed by the water up to the split and motionless state is a constant quantity at all temperatures for the same substance. He calls this quantity the absolute splitting heat; the splitting heat above any standard state he calls the nominal splitting heat, *S* a constant quantity for all temperatures. From the entropy calculation for more than twenty temperatures, all calculate to seven places of decimals from Regnault's exact formula (*H*) for saturated steam, he takes two temperatures indiscriminately, and equates the value of *S* expressed in entropy quantities with one unknown quantity, the specific heat entropy.

| | |
|---|---|
| Equating 278° C. with 374° C. gives ... | ·387729 |
| ,, 278° C. with 494° C. gives ... | ·387867 |
| | 2)·775596 |
| Mean calculated specific heat ... ... | ·387798 |
| Instead of ... ... ... ... ... ... | ·387779 |
| Difference ... ... ... | ·000019 |

The value of *S* above melted ice is for water

| | |
|---|---|
| Calculated at 278° ... ... ... ... | *S* = 502·386 |
| ,, 294° ... ... ... ... | *S* = 502·405 |
| | 2)1004·791 |
| | 502·395 C. |
| or | 904·311 F. |

This is a remarkable corroboration of the kinetic theory of gases, quite unlooked for in steam experiments, and, as the author of the paper remarked, it shows how reliable are the results of the experimenter Regnault. The author also explained a new diagram, in which the area is energy, the length entropy, and the height temperature. In such a diagram it becomes as simple an idea as temperature. From this it appears that the ratio of the two specific heats is 1·4 for steam.—Mr. Clark communicated a paper on the behaviour of liquids and gases near their critical temperatures.—Mr. Winstanley exhibited two new varieties of air-thermometers and a thermograph actuated by an air-thermometer on the principle of his radiograph exhibited at last meeting. The first thermometer consists of a U tube with terminal bulbs and the left leg of much finer bore than the right. Mercury is in the right leg, sulphuric acid surmounted with air in the left. The apparatus is a barometer to the air inside the left bulb, and a thermometer to that outside. A similar combination of an air-thermometer and an aneroid barometer constitutes the second instrument. The expansion or contraction of the air in the stem by external temperature expands or compresses a small aneroid chamber in the bulb.—Mr. Gee and Mr. Stroud made a communication on a modification of Bunsen's calorimeter, which will be found in the *Proceedings* of the Society.—The meeting then adjourned till the winter session commences.

**Geological Society**, June 23.—Robert Etheridge, F.R.S., president, in the chair.—Edwin Muir, Benjamin Sykes, and John Thorburn were elected Fellows of the Society. The following communications were read:—On the skull of an *Ichthyosaurus* from the lias of Whitby, apparently indicating a new species (*I. zetlandicus*, Seeley), preserved in the Woodwardian Museum of the University of Cambridge, by Prof. H. G. Seeley, F.R.S.—Note on the cranial characters of a large Teleosaur from the Whitby lias, preserved in the Woodwardian Museum of the University of Cambridge, by Prof. H. G. Seeley, F.R.S.—On the discovery of the place where Palæolithic implements were made at Crayford, by F. C. J. Spurrell, F.G.S.—The geology of Central Wales, by Walter Keeping, F.G.S., with an appendix by C. Lapworth, F.G.S., on a new species of *Cladophora*.—On new Erian (Devonian) plants, by J. W. Dawson, F.R.S. The paper first referred to recent publications bearing on the Erian (Devonian) flora of North-East America, and then proceeded to describe new species from New York and New Brunswick, and to notice others from Queensland, Australia, and Scotland. The first and most interesting is a small tree-fern, *Asteropteris noveboracensis*, characterised by an axial cylinder composed of radiating vertical plates of scalariform tissue imbedded in parenchyma and surrounded by an outer cylinder penetrated with leaf-bundles with dumb bell-shaped vascular centres. The specimen was collected by Mr. B. Wright in the Upper Devonian of New York. Another new fern from New York is a species of *Equisetides* (*E. wrightianum*), showing a hairy or bristly surface, and sheaths of about twelve short acuminate leaves. A new and peculiar form of wood, obtained by Prof. Clarke of Amherst College, Massachusetts, from the Devonian of New York, was described under the name *Celluloxylon primævum*. It presents some analogies with *Prototaxites* and with *Aphyllum paradoxum* of Unger. Several new ferns were described from the well-known Middle Devonian plant-beds of St. John's, New Brunswick; and new facts were mentioned as confirmatory of the age assigned to these beds, as showing the harmony of their flora with that of the Erian of New York, and as illustrating the fact that the flora of the Middle and Upper Devonian was eminently distinguished by the number and variety of its species of ferns, both herbaceous and arborescent. It will probably be found eventually that in ferns, equisetaceous plants, and conifers, the Devonian was relatively richer than the Carboniferous. Reference was also made to a seed of the genus *Ætheotesta* of Charles Brongniart, found by the Rev. T. Broun in the Old Red Sandstone of Perthshire, Scotland, and to a species of the genus *Dicranophyllum* of Grand'-Eury, discovered by Mr. J. L. Jack, F.G.S., in the Devonian of Queensland. In all, this paper added six or seven new types to the flora of the Erian period. Several of them belong to generic forms not previously traced further back than the Carboniferous. The author uses the term "Erian" for that great system of formations intervening in America between the Upper Silurian and the Lower Carboniferous, and which, in the present uncertainty as to formations of this age in Great Britain, should be regarded as the type of the formations of the period. It is the "Erie Division" of the original Survey of New York, and is spread around the shores of Lake Erie, and to a great distance to the southward.—On the terminations of some Ammonites from the inferior oolite of Dorset and Somerset, by James Buckman, F.L.S.—Faröe Islands: Notes upon the coal found at Suderöe, by Arthur H. Stokes, F.G.S.—On some new cretaceous *Comatulæ*, by P. Herbert Carpenter, M.A. Communicated by Prof. P. Martin Duncan, F.R.S.—On the Old Red Sandstone of the north of Ireland, by F. Nolan, M.R.I.A. Communicated by Prof. Hull, F.R.S.—A review of the family Vincularidæ, recent and fossil, for the purpose of classification, by G. R. Vine. Communicated by Prof. P. M. Duncan, F.R.S.—On the zones of marine fossils in the calciferous sandstone series of Fife, by James W. Kirkby. Communicated by Prof. T. Rupert Jones, F.R.S.—The glaciation of the Orkney Islands, by B. N. Peach, F.G.S., and John Horne, F.G.S. In this paper, which forms a sequel to their description of the glaciation of the Shetland Isles, the authors, after sketching the geological structure of Orkney, proceeded to discuss the glacial phenomena. From an examination of the various striated surfaces they inferred that the ice which glaciated Orkney must have crossed the islands in a north-westerly direction from the North Sea to the Atlantic. They showed that the dispersal of the stones in the boulder-clay completely substantiates this conclusion; for in Westray this deposit contains blocks of red sandstone derived from the Island of Eda, while in Shapincha blocks of slaggy diabase, occurring *in situ* on the south-east shore, are found in the boulder-clay of the north-west of the island. Again, on the mainland, blocks of the coarse siliceous sandstones which cross the island from Inganess to Orplin are met with in the boulder-clay between Honton Head and the Loch of Slennis. Moreover, they discovered in the boulder-clay the following rocks, which are foreign to the island: chalk, chalk-flints, oolitic limestone, oolitic breccia, dark limestone of Calciferous-sandstone age, quartzites, gneiss, &c., some of which closely resemble the representatives of these formations on the east of Scotland, and have doubtless been derived from thence. From this they infer that, while Shetland was glaciated by the Scandinavian *mer de glace*, Orkney was glaciated by the Scotch ice-sheet, the respective ice sheets having coalesced on the floor of the North Sea and moved in a north-westerly direction towards the Atlantic. They also found abundant fragments of marine shells in most of the boulder-clay sections, which are smoothed and striated precisely like the stones in that deposit. They conclude that these organisms lived in the North Sea prior to the great extension of the ice, and that their remains were commingled with the *moraine profonde* as the ice-sheet crept over the ocean-bed. From the marked absence of shell-fragments in the Shetland boulder-clay they are inclined to believe that much of the present sea-floor round that group of islands formed dry land during the climax of glacial cold.

### PARIS

**Academy of Sciences**, July 5.—M. Edm. Becquerel in the chair.—The death of M. Borchardt (correspondent in Geometry) was announced.—The following papers were read:—Study of the variation of the line of sight, on the great meridian circle of Paris Observatory (constructed by M. Eichens), by means of a new apparatus, by M. Loewy. The essential part is a small glass disk giving simultaneously three images in the eye-piece: (1) that of the cross wires, (2) that of a division drawn on the objective, and (3) that of one of the divisions of a plate inserted in the axis.—On the photography of the chromosphere, by M. Janssen. The exposure is continued till the solar image is positive to the border; the chromosphere then appears as a dark circle 8" or 10" in width.—On the integration of linear equations by means of the sines of superior orders, by M. Villarceau.—On the consequences of the experiment of MM. Lontin and de Fonvielle, by M. Jamin. He indicates experiments which should test his explanation.—On the vision of colours, by M. Chevreul.—On some general relations between the chemical mass of elements and the heat of formation of their combinations (continued), by M. Berthelot. The influence of mass of the elements in diminishing the stability, and therefore the heat liberated, may be conceived simply by supposing that the system formed by two molecules will be more exposed to destruction by movements of the whole system (rotations, vibrations, &c.,) the heavier the molecules. On the other hand, the reserve of energy (which is gradually expended in combination), should, *ceteris paribus*, be greater in light elements than in heavy ones.—Epochs of vegetation for the same tree in 1879 and in 1880, by M. Duchartre. Though the temperature was much more severe in December and January last than the previous year, the renewal of vegetation in six chestnuts was earlier. The mild time between the cold of December, 1879, and January, 1880, does not account for this, for a longer and milder time intervened in 1878–79. Nor does the method of sums of heat explain it. But the trees received more heat this year from the beginning of vegetation to complete expansion of their leaves.—On a meteorite which fell on November 16, 1874 at Kerilis (Côtes du Nord), by M. Daubrée. This belonged to the sub-group Oligosideres in the Sporadosideres.—On a meteorite which fell on September 6, 1841, in the vineyards of Saint Christophe-la-Chartreuse (Vendée), by M. Daubrée.—Inquiry into the situation of agriculture in France in 1879, by M. Chevreul.—On the utility of quarantines, by M. de Lesseps. He gives examples of their inadequacy.—Nature of the immunity of Algerian sheep against spleen-disease; is it an aptitude of race? by M. Chauveau. The property is congenital and natural. It may be communicated by crossing to European sheep. French sheep bred in Algeria do not acquire it, and it is not proved that Algerian sheep bred in France may not lose it.—Determination of the difference of longitude between Paris and Bonn, by MM. Le Clerc and De Bernardières. The figures obtained are 19m. 2·269s., probable error ± 0·009s. German astronomers found for the same arc, 19m. 2·231s.—Some remarks on the equation of Lamé, by M. Escary.—Integration of any number of simultaneous equations between a given number of functions of two independent variables and their partial derivatives of the first order, by M. Turquan.—On the bright spectral lines of scandium, by M. Thalén.—Improvements in Siemens' bobbins, by M. Trouvé. He suppresses the two periods of indifference, making the polar faces of snail form, so that the surfaces approach those of the magnet gradually, till the moment that the posterior edge escapes from the pole, when repulsion commences. The work is thus economised.—On the sensibility of the eye to differences of light, by M. Charpentier. A given light, strong or weak, must (in his case) be increased or diminished about eight hundredths to give a distinct new sensation; and it seems to be the same in indirect vision as in direct, and with coloured as with white light.—Thermic study of polysulphides of ammonium and persulphide of hydrogen, by M. Sabatier.—On the density of iodine vapour, by M. Troost. He finds it to diminish both at a low and at a high temperature, so that dissociation or isomeric change seems hardly admissible.—On the atomic weight and on some characteristic salts of ytterbium, by M. Nilson.—On the dissolution of platinum in sulphuric acid, by M. Scheurer-Kestner. The attack of platinum is always due to presence of nitrogenised compounds in the sulphuric acid.—Remarks on etherification of hydracids, by M. Villiers.—Atmospheric bacteria, by M. Miquel. The number, very small in winter, increases in spring, and is high in summer and autumn; but while spores of mould are abundant in wet, and rare in dry, periods, it is the opposite with aërial bacteria. At Montsouris, in summer and autumn, 1,000 germs of bacteria are sometimes found in 1 cubic metre; in winter the number may go down to 4 or 5, and on some days 200 litres of air are insufficient to infect the most alterable liquors. In ordinary houses air proves fertilising (to neutral bouillon) in a volume of 30 to 50 litres. M. Miquel notes an increase of deaths from contagious and epidemic diseases in Paris, about eight days after a recrudescence of aërial bacteria. Water vapour from the ground, rivers, or putrefying masses is always micrographically pure.—On a digestive ferment contained in the sap of the fig, by M. Bouchut.—A work by M. de Koninck, on the fauna of the carboniferous formation of Belgium, was presented.

### VIENNA

**Imperial Academy of Sciences**, May 7.—B. Bolzano's significance in the history of infinitesimal calculation, by Prof. Stolz.—Investigation of the roast products of coffee, by Herr Bernheimer.—On direct introduction of carbonyl groups into phenols and aromatic acids (third part); behaviour of pyrogallic and gallic acids with carbonate of ammonia, by Prof. Senhofer and Dr. Brunner.—On Guthrie's cryohydrates, by Herr Offen.—On the relation of the coefficients of diffusion of gases to the temperature, by Herr von Obermayer.—On the coincidence of disorders of the skin and of the grey axis of the spinal cord, by Dr. Jarisch.

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